



## **MCEETYA ICT in Schools Taskforce**

### *STUDENTS IN A DIGITAL AGE: SOME IMPLICATIONS OF ICT FOR TEACHING AND LEARNING*

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Over recent decades there have been major changes in economic and social life associated with the roles of knowledge and technology in the lives of communities. One of these has concerned the production, distribution and use of new knowledge as contributor to economic growth and as a product of economic activity: the “knowledge economy” (OECD, 1996). A second has been the development and widespread implementation of information and communication technologies (ICT) throughout society: the “information society” (European Commission, 2000). As Kozma (2003) observes, ICT provides the tools needed by the knowledge economy and the information society to create, collect, store and use knowledge as well as to connect with people and resources across the world and collaborate. The advent of ICT has changed the environment in which students develop in society in ways that impact on the way they learn in schools.

### **Perspectives from young people**

It is commonly observed that ICT is now more than a tool and it infiltrates every part of life (Prensky, 2004). Young people are increasingly aware of the importance of being able to utilise current technologies. In one large survey in the United States 82% of children in Years K to 3, and 95% of children in Years 3 to 6 answered “yes” to the question “do you think it is important for students your age to be able to use technology?” (NetDay, 2004)<sup>1</sup>. Furthermore, the advent of the internet has changed the way people communicate. NetDay (2004) found that 54% of students in Years 6 to 12 in the United States answered ‘yes’ to the question ‘do you know more of your friends instant message (IM) screen names than their home phone numbers?’

The internet impacts on family dynamics, in that children, rather than adults are seen as the ‘experts’ in this domain. This is despite 30% of children in the United Kingdom having received no lessons at all on using the internet (Livingstone & Bober, 2005)<sup>2</sup>. In the United States 48% of students in Years 6 to 12 stated that they learned about technology on their own (NetDay, 2004). Lenhart, Rainie and Lewis (2001)(cited in Bailey (2003)) report that 64% of teenagers who use the internet say they know more about the internet than their parents, and 66% of parents concur.

These changes associated with the advent of information and communication technologies have significant ramifications for teachers and schools because they have changed the ways in which young people access and process information and they ways in which they communicate with each other (Livingstone & Bober, 2005, Prensky, 2004).

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<sup>1</sup> In this survey students from 3000 schools submitted 210,000 surveys regarding student views on technology and education (NetDay, 2004).

<sup>2</sup> For the *UK Children Go online* reports the project investigated the use of the internet by 9-19 year olds through observations, surveys (of children and in some cases, their parents) and focus group interviews.

## Computers at home: PISA data

The OECD Programme for International Student Assessment (PISA) gathered information about student use of ICT from large representative national samples of 15-year-old students using its student questionnaire in 2003 (OECD, 2004)<sup>3</sup>. From these data it was found that 93% of Australian students had a computer at home that they could use for school work<sup>4</sup>, 83% had a link to the internet and 67% had educational software for the computer.

Table 1 records the percentages of 15-year-old students in OECD countries that had respectively “a computer at home that could be used for school work” and “a link to the internet” at home. These data provide informative comparisons because they are based on a common questionnaire in all countries and are derived from representative samples with high response rates.

Apart from the generally high percentage of students with computers at home in Australia and in OECD countries generally, it can be seen that Australia is one of 11 OECD countries with more than 90% of students having a computer at home and one of nine OECD countries with more than 80% of students having an internet connection at home. Australia was one of four countries where more than 60% of students indicated that they had educational software for the home computer.

**Table 1 Fifteen-year-old students with computers at home**

	% students with a:	
	Computer	Internet
Australia	93	83
Austria	93	71
Belgium	88	76
Canada	91	85
Czech Rep.	79	52
Denmark	93	83
Finland	89	78
France	80	56
Germany	91	74
United Kingdom	91	80
Greece	52	35
Hungary	67	26
Ireland	80	67
Iceland	97	92
Italy	83	67
Japan	44	61
Korea	95	93
Luxembourg	90	75
Macedonia	89	67
Mexico	38	20
New Zealand	88	83
Norway	94	88
Netherlands	96	88
Poland	61	33
Portugal	74	47
Slovak Rep.	60	19

<sup>3</sup> In Australia PISA 2003 involved 321 schools and just over 12 500 students participated in PISA (Thomson Cresswell & de Bortoli, 2004). Internationally PISA 2003 involved more than one-quarter of a million students in 41 countries (all 30 OECD member countries and 11 non-OECD countries).

<sup>4</sup> Another question asks simply whether there is a computer at home. For Australia 96% of students indicated that there was a computer at home.

Spain	83	55
Sweden	95	89
Switzerland	87	77
Turkey	24	14
USA	89	80
Yugoslavia	39	26

*Source: PISA 2003 student questionnaire*

The PISA data for 15-year-olds in Australia and other countries are similar to other reported data about the use of computer technology. The Trends in Mathematics and Science Study (TIMSS) reports that 96% of Year 8 students, and 92% of Year 4 students, in Australia have a computer at home (Thomson & Fleming, 2004: 67). Corresponding percentages for Year 8 students for other countries were 93% in the United States, 91% in New Zealand, 94% in England, 98% in the Netherlands and 94% in Singapore. Among Year 4 students the percentages having a computer at home were 92% in the United States, 91% in England, 87% in New Zealand, 93% in the Netherlands and 89% in Singapore (Martin et al, 2004).

From the United Kingdom it is reported that 75% of 9 to 19-year-olds had accessed the internet from their home and 92% had accessed the internet from school (Livingstone & Bober, 2005). In the United States it is reported that 83% of American family households owned a computer and 78% of children have internet access at home (Corporation for Public Broadcasting, 2003).

### **Using computers**

PISA 2003 also provides information about the extent of usage of computers by 15-year-olds in Australia.

- All of the 15-year-old students had used a computer, 90% had used a computer for more than three years and 69% had used a computer for more than five years.
- More than half (55%) of the students used a computer at home almost every day (and further 32% used a computer at home a few times each week).
- Some 15% of students used a computer almost every day at school with a further 44% using a computer at school a few times each week.

Responses from a national survey in the United States indicated that in 1998, more than 75% of students had access to computers at school and more than half use computers at school several times per week (cited in Becker, 2000)<sup>5</sup>.

### **Student computer use**

Internet access is a common application of computer technology for young people. In the United Kingdom 41% of 9 to 19-year-olds are daily, and 43% are weekly users of the internet, with 19% spending about ten minutes per day online, and 48% spending between half an hour and one hour. (Livingstone & Bober, 2005). Only 16% of this age group rarely or never use the internet. (Livingstone & Bober, 2005).

In the United States online children aged 6 to 17 use the internet an average of 5.9 hours per week at home. There is increasing usage with age, with the average time spent online per week being 2.7 hours for children aged from 6 to 8, 4.4 hours for children aged between 9 and 12, and 8.4 hours for teenagers (Corporation for Public Broadcasting, 2003).

Data from PISA 2003 provide information about the extent to which different sorts of computer applications are used by 15-year-old students in Australia and other countries. The percentages of 15-

<sup>5</sup> (Teaching, Learning and Computing: 1998 – A National Survey of Schools & Teachers; TLC-1998)

year-old Australian students who used various functions of a computer at least “a few times each week”<sup>6</sup> are shown in Table 2.

The most frequent uses that 15-year-old Australian students made of computers (at home or at school) were for “looking up information about people, things or ideas”, “word processing” and “electronic communication (eg email or chat rooms).

The least frequent uses that 15-year-olds made of computers were “educational software such as mathematics programs”, “spreadsheets” and “programming”.

**Table 2 Percentages of fifteen-year-old Australian students using computer functions at least a few times each week.**

Function	% using weekly
Look up information	74
Word processing	70
Communication (email & chat)	69
Download music	58
Computer games	50
Download software	47
Collaborate with a group	43
Drawing or graphics programs	32
Learn school material	32
Programming	25
Spreadsheets	22
Educational software (eg maths)	10

Source: PISA 2003 student questionnaire

## Students responses to computers

In general it appears that students are favourably disposed towards working with computers. Four questions in the PISA 2003 student questionnaire asked students about their experience of working with computers. Table 3 records the percentage of 15-year-old Australian students who either agreed or strongly agreed with these statements.

**Table 3 Percentages of fifteen-year-old Australian students agreeing with statements about computer use**

Statement	%	
	Strongly Agree	Agree
...important to me to work with a computer	45	43
...working with a computer is fun	43	46
...use a computer because very interested	35	40
...lose track of time when working with a computer	34	37

Source: PISA 2003 student questionnaire

<sup>6</sup> These estimates combine the percentages for those who said that they used the application “almost every day” with those who said that they used it “a few times each week”.

## Other information technologies

Young people use forms of information technology other than computers. In the United Kingdom 71% of 9 to 19 year olds have a computer, 38% have a mobile phone, 17% have a digital television, all of which have internet access (Livingstone & Bober, 2005). Some 82% of American children play video games on a regular basis, for an average of 8.2 hours per week (cited in Jukes, 2005, p.7). A report by the Corporation for Public Broadcasting (2003) found that teenagers use 'digital media' (including video games and non internet related use of computers) for an average of 3.5 hours per day.

## Inequalities in internet access

Becker (2000) discussed concerns about an emerging 'digital divide' between those students who are benefiting and those who are being left behind by new technologies. Drawing on data from a national survey in the United States, Becker indicated that those teaching students from lower income families reported more frequent use of computers than those teaching higher-income students. However, the nature of student's experiences using computers in schools varied greatly by subject and teacher. His analysis suggested that lower-income students use computers more often for repetitive practice, whereas higher-income students use computers more often for more intellectually complex applications.

Becker (2000) also discussed differences between children from low-income and high-income families in terms of access to home computers. Those analyses indicated that only 22% of children in families with family incomes of less than \$20,000 had access to a home computer, compared to 91% of those in families with annual incomes of more than \$75,000.

## ICT in schools and classrooms

ICT finds a range of applications in schools and classrooms and is frequently associated with innovative pedagogical practices. Module 2 of the Second Information Technology in Education Study (SITES) set out to describe and investigate innovations that made use of ICT to enhance pedagogy (Kozma, 2003). SITES analysed 174 cases of exemplary practice from 28 countries (Australia contributed five cases). Each case was investigated intensively using qualitative and quantitative methods using a common framework. The results were synthesised so as to provide an overview that utilised the variation that is present across so many education systems.

SITES identified seven patterns (or clusters).

- *Tool use* including communication and productivity tools such as word processing, spreadsheets, databases, and multimedia.
- *Student collaborative research* involving groups collecting and analysing data.
- *Information management* focussing on searching for, organising, managing and using information for teaching and learning.
- *Teacher collaboration* that often focussed on design of instructional materials and activities (the majority of these were from upper secondary schools).
- *Outside communication* that involved students working with others outside the classroom and was characterised by the use of email, the Internet, conferencing software and listserves.
- *Product creation* that focused on the design of digital products
- *Tutorial projects* in which software was used to provide opportunities to practice and refine skills.

## ICT and learning

### *Approaches to learning*

One aspect of studies concerned with information technology is concerned with whether there are differences in approaches to learning between those who grew up with digital technologies and those who did not. Some writers argue that there are fundamental differences between these two groups of learners (Jukes, 2005; Prensky, 2004; Tapscott, 2004)<sup>7</sup>.

Perhaps the most obvious outworking of this is that if students have the inclination to pursue an interest in a topic, now, perhaps more than ever, the tools are available to do this, whereas in the past, access to information was far more limited (Prensky, 2004; Jukes, 2005). Technology can therefore encourage the development of independent learners (NetDay, 2004).

Of course this use of the available tools applies only when students are motivated to learn about a specific topic. Prensky argues in a later paper another key difference in today's learners is that they are accustomed to being engaged, and school frequently compares unfavourably to the 'thrills' that technology offers (Prensky, 2005).

Jukes (2005) suggests that another difference in learning is that those who grew up with new technologies assume that the process of learning to use a new device or program will be inherent in that program. Learning then, is interactive and practical, taking place mainly through experimentation. This postulation is consistent with the research data from the *UK kids go online* project (Livingstone & Bober, 2005) which suggested that, specifically with regard to using the internet, learning is action based, and learning through trial and error is the most prevalent approach.

Some of Jukes (2005) suggestions for how teaching should be adapted to better meet the needs of today's learners are: increasing the speed at which information is presented, providing opportunities for multitasking and interactive learning and presenting information through a variety of media.

### *Listening to students voices*

A second theme concerns the opportunities provided for interaction with students. Levin & Arafeh (2002) found that teenagers in the United States were well able to articulate the significant advantages of using the internet to assist with schoolwork. The ability to obtain up to date information was important. Students also indicated that by using the internet, they were less likely to panic when confronted with unfamiliar or difficult material, and that using the internet assisted them to balance the competing demands of their academic and social lives.

Interestingly in the same study, students reported that for the most part, their use of the internet for educational purposes took place outside school hours, and therefore outside of parameters set by the school for its use. Where the internet was used for instruction, students for the most part, reported the activities as unengaging. Many expressed a desire to be given internet-based assignments that were engaging, and further, felt that this would improve their attitude to school and schoolwork (Levin & Arafeh, 2002).

Lack of access to the internet was seen as a barrier to using the internet at school, both in terms of the availability of fast internet connections and the problems of filtering software, which can often block legitimate educational websites (Levin & Arafeh, 2002).

The NetDay (2004) survey shows that students of all ages have strong views on how technology should/ could be incorporated more fully into education. The main focus of the ideas expressed in this survey was on increased use of computers in the classroom, accompanied by greater access to the internet and a range of educational software at school.

### *Possibilities for students with disabilities*

Hasselbring and Williams Glaser (2000) discuss the role of computer-based technologies for students

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<sup>7</sup> These writers use the terms "digital natives" and "digital immigrants" to encapsulate the differences.

with special needs. They argue that the use of computer technology for word processing, communication, and multimedia projects can help students with specific learning and emotional disorders keep up with their peers. Computer technology has also enhanced the development of sophisticated devices that can assist students with more severe disabilities in overcoming a wide range of limitations that hinder classroom participation: speech and hearing impairments, visual impairment and physical disabilities. However, Hasselbring & Williams Glasser (2000) identified that many teachers are not adequately trained on how to use technology effectively in their classrooms, and the cost of the technology is a serious consideration for all schools. Thus, although computer technology has the potential to assist students with disabilities, the barriers of inadequate training and cost must first be overcome before more wide-spread use can become a reality.

#### *Availability of resources*

Becker (2000) identified that how frequently a student uses computers at school, and for what, depends greatly on how many computers are available and whether they are located within the classroom or elsewhere. Especially in high school academic classrooms a shortage of individual computer stations in the classroom has long restricted more frequent, systematic, and well-integrated use of technology.

#### *Other aspects of technology and learning*

There is increasing recognition that new technologies, such as computer games, have the potential to lead to learning. Sohn (2004) outlines the argument that video games can lead to, for example improved attention and reading skills as well as inspiring new interests<sup>8</sup>. Roschell et al. (2000) explore the various ways that computer technology can be used to improve how and what children learn in the classroom. Several examples of computer-based applications are highlighted to illustrate ways technology can enhance how children learn by supporting four fundamental characteristics of learning: active engagement; participation in groups; frequent interaction with feedback; and connections to real-world contexts.

The importance of assisting teachers to learn to use and apply technology in the classroom cannot be underestimated (Shields & Behrman, 2000). Shields and Behrman (2000) assert that collaboration with other education professionals is an important method through which teachers learn. In order to encourage such activities with specific regard to linking education and technology, rewards could be put in place.

Roschelle et al. (2002) argues that the use of technology as an effective learning tool is more likely to take place when embedded in a broader education reform movement that includes improvements in teacher training, curriculum, student assessment and a school's capacity for change.

#### *Cautionary notes*

There are numerous articles that counsel against the widespread adoption of information technology in school learning (Cuban, 2001). Those articles argue that many technology-based instructional programs have had at best a limited impact on student learning. Roschelle et al. (2000) observed that studies conducted on the effectiveness of technology in the classroom often have mixed results, making it difficult to generalise about technology's overall impact in improving learning. They suggested three key reasons that contribute to these mixed results:

- hardware and software variations among schools and even greater variation in the ways schools use technology;
- successful use of technology is always accompanied by concurrent reforms in other areas such as curriculum, assessment and teacher professional development, so the gains in learning cannot be attributed to the use of technology alone; and
- few rigorously structured longitudinal studies that measure growth in relations to the use of

technology in educational settings have been conducted.

### **Internet use for learning**

Among 9 to 19 year olds in the UK, the internet is overwhelmingly used in ways that relate directly, or indirectly, to learning. Some 90% of those who use the internet daily or weekly do so to do schoolwork and 94% use it as a research tool for obtaining information. (Livingstone & Bober, 2005). In Canada teenagers are reported to spend 2.4 hours per week of their time online on activities explicitly related to learning, such as researching information from school projects. Use of the internet to research information differs according to subject area, with 56% of Canadian teenagers using the internet to research information for science classes, 42% for social science classes, and 36% for English classes.

Levin & Arafeh (2002) conducted interviews with American teenagers and found that the internet was used for a wide range of education-related purposes, from research, to corresponding with teachers and classmates about school projects. This finding is particularly interesting in light of reports such as the Canadian Inter@ctive Reid Report, which found in a survey of 12 to 17 year olds that the majority of internet use was for the purpose of activities related to socialising (e.g., e-mailing and using instant messaging) rather than education, as it suggests that these two areas cannot be viewed as independent from one another.

The report by the Corporation for Public Broadcasting (2003) found that 20% of children use the internet every day for educational purposes, while 64% of teenagers reported using the internet for educational purposes weekly. NetDay (2004) reported that 73% of students in Years K to 3 reported that they used computers to help with their schoolwork. Similarly, an average of 75% (across two surveys) of students in Years 3 to 6 reported using technology to help with their schoolwork. When the same question was asked of students in Years 6-12 the figure was 84%. NetDay (2004) reported that, across two surveys, an average of 43% of US students in Years 3-6, and 67% of students in Years 6 to 12, indicated using information technology as their most likely first step in writing a school report.

### **Conclusion**

These statistics provide a forceful reminder that, not only have advances in technology changed the way today's learners communicate and socialise, but have fundamentally impacted the way they approach learning. Already, the fields of technology and education have been all but inextricably linked, for the most part, by students themselves, who are anxious to use the new ways of researching, organising and processing information that technology offers. The response of educators to this new climate has begun, but much lies ahead and this much is certain: educators ignore the impact of technology on teaching and learning at their peril.

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